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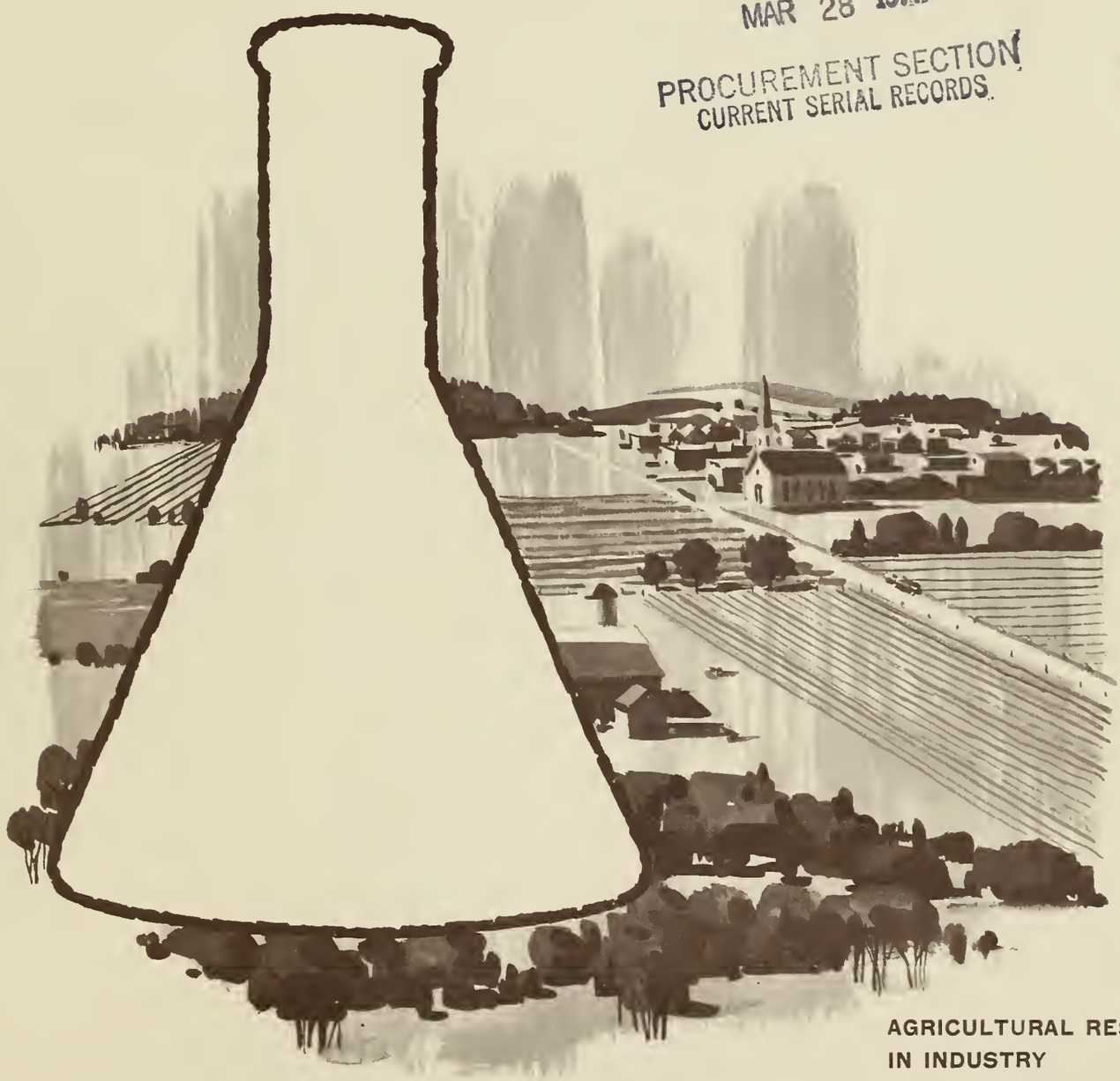
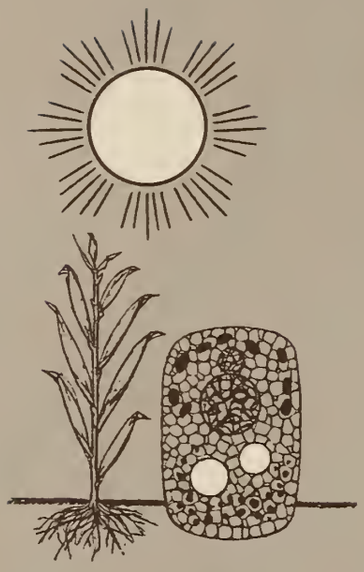


THIRD QUARTER 1967



AGRICULTURAL SCIENCE REVIEW

Third Quarter 1967 Vol. 5 No. 3

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Research Is No Cure-All

One of the recommendations proposed at the Nebraska home economics conference was that research projects be set up to try to solve some of the communications problems that are bothering home economists.

We don't deny that such problems exist. To cite one instance—it must be very frustrating to social welfare workers to see homemakers from disadvantaged families throw away free packages of rice simply because they didn't know what it was or how to cook it. (This incident actually happened in one Appalachia region.)

Nor do we deny the efficacy of research. Any science journal editor worth his salt generally has a healthy respect for the methods of science and for scientists themselves. Undoubtedly some of the problems in communication do need the benefit of a rational, scientific approach.

But the point your *Review* editor wants to make is that home economists might first consider some more obvious approaches to such problems. As a starter, we suggest tapping the resources of information departments and journalism schools in land-grant colleges. Conceivably, the solution to some problems might turn out to be much simpler than one would realize. In other words, the resource of years of training and experience in methods of sharing new ideas with the rural sector could turn out to be a right handy fountain of knowledge.

Science editors have long advocated the following precept to scientists: Decide what you want to say and then say it as simply and clearly as you can. There is no better way to get your message across. Of course the trouble is that some scientists refuse to endure the supposed indignity of clear speech and writing. It is only natural, therefore, when scientists are confronted with a communication barrier, they sometimes look to research for a way to overcome it. Some do nothing, of course, and are content to let their readers and listeners remain confused. On that basis, then, the fact that home economists recognize a problem and are eager to do something about it—this is a commendable attribute.—W. W. K.

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AGRICULTURAL RESEARCH AND DEVELOPMENT

by the Private Sector of the United States

H. L. WILCKE and H. B. SPRAGUE

IT is common knowledge that many agricultural industries conduct research on agricultural matters to meet their own immediate and long range needs. In addition some agricultural associations and institutes, as well as several private foundations, invest some of their resources not only in agri-related research but also in support of agricultural research conducted by universities and the U.S. Department of Agriculture. What has not been known is (*a*) the extent or volume of the research effort by the private sector, (*b*) the kinds of research and development undertaken, and (*c*) the role of such private activities in relation to that accomplished by Federal and State agencies. Moreover, there was scant evidence as to what the private agencies might be planning in the future, say, up to 1975. Now, however, as a result of a nationwide study of the private sector of the United States, much more knowledge about these matters has become available. This article summarizes that study, data for which were drawn from information contributed directly by some 250 private companies, associations, institutes, and foundations.

This unique study of the private sector resulted from a request by the Senate Committee on Appropriations in early 1965 that the Secretary of Agriculture establish a research review committee to examine fully each and every line of agricultural research conducted by the U.S. Department of Agriculture and by the State agricultural experiment stations. The Secretary and the Chairman of the Executive Committee of the National Association of State Universities and Land Grant Colleges agreed in May 1965 that the study should be conducted jointly. A joint committee of six from USDA and six from the State agricultural experiment stations was formed. This committee recommended that a comparable study should be made of agricultural research in the private sector, and the Secretary of Agriculture authorized this enlargement of the original directive.

Upon a request from the Joint Committee, the Agricultural Research Institute (ARI) agreed to undertake the task of obtaining the desired information from all private sectors of the economy concerned with agricultural research. A special committee [1] composed of M. B. Gillis, chairman, S. G.

[1] M. B. Gillis (International Minerals & Chemical Corp.) vice president, ARI; S. G. Younkin (Campbell Soup Co.) past president, ARI; and H. L. Wilcke (Ralston Purina Co.) president, ARI.

Younkin, and H. L. Wilcke, with H. B. Sprague as secretary, worked closely with the Joint Committee in drafting a questionnaire. This form was simplified as much as possible in an effort to persuade organizations to respond, but it followed the general features of the questionnaires which the Federal research units and the State agricultural experiment station used for their reports. Recording and classifying the information from both public and private sectors on essentially the same basis would therefore facilitate direct comparisons and evaluations from a variety of approaches.

The committee could foresee two possible obstacles to obtaining information from private industry: (*a*) the understandable reluctance to reveal information that might compromise the programs of any individual company if transmitted to its competitors, and (*b*) the mistrust surrounding the release of information that might be used by another government agency to challenge the validity of reports submitted to comply with governmental requirements. These obstacles were partly overcome by the nature of the Agricultural Research Institute which is a private, nearly autonomous, organization affiliated with the National Academy of Sciences—National Research Council, but having no connection with or responsibility to any branch of government. A further protection to responding companies was the guarantee that all reports, upon arrival, would be given a code number by ARI, and that there would be nothing placed on any report that could be used to identify the source of the information. The Agricultural Research Institute has kept faith on this promise and has protected the identity of all reports.

Compiling the Roster

A LIST of 825 private organizations large enough to be capable of significant activity in agricultural research and development was compiled from available directories, trade associations and institutes, and commercial magazines. No doubt some important companies were omitted, but as will be noted later, this method probably produced conservative rather than exaggerated estimates. The simplified questionnaire sent to each organization asked for research and development information for 1965 and an estimate for 1975.

Of the 815 organizations queried, 252 responded and completed the questionnaire; 380 did not respond; and 193 reported they were not engaged in research or declined to report for other reasons. Of the 252 respondents, 5 gave incomplete replies, thus leaving 247 satisfactory questionnaires.

It was important to determine whether the 247 replies constituted a valid sample of the private sector. The following assumptions were made:

1. That the same proportion of the 380 nonresponding organizations were engaged in agricultural research and development as for the organizations that replied, thus producing 212 organizations having significant research and development programs.
2. That the average annual research programs of these 212 organizations would be of the same magnitude as for the organizations providing detailed reports, that is, approximately $1 million each.
3. That the ratios of kinds of research and development would be similar for the nonrespondents as for the respondents.

TABLE 1.—*Expenditures and manpower applied to research and development by private organizations and foundations*

Item	1965	Projected to 1975
Total research and development expenditures	$460 million	$759 million (est.)
Percentage increase		66 percent
Number of scientists and engineers employed	8,732	16,000 (est.)
Percentage increase		66 percent

An examination of the roster of nonrespondents in comparison with the roster (not the reports) of the respondents provided a rough estimate of the validity of these assumptions, in the judgment of the special ARI Committee. It was concluded that these assumptions were tenable on the basis of general information available, and that the extrapolation of 247 valid reports to represent the entire private sector probably erred on the side of being somewhat too conservative. All data reported hereafter are based on these assumptions, and purport to cover the entire private sector concerned with agricultural research and development.

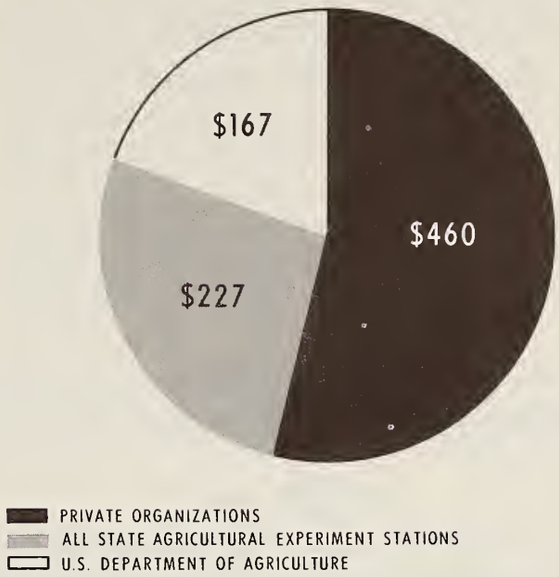
Relative Contributions

THE report, *A National Program of Research for Agriculture*,[2] shows the relative contributions to agricultural research and development in 1965 (fig. 1). This enormous activity of the private sector is expected to expand in the current decade, as shown by table 1.

Projections for a 10-year period in a rapidly moving economy as now exists are certainly only approximations. But the collective estimates of all private sector organizations point toward a growing activity in agricultural research and development.

It is quite significant to evaluate the kinds of research that industry supports in relation to the kinds that engage the resources and manpower

FIGURE 1. RELATIVE CONTRIBUTIONS TO AGRICULTURAL RESEARCH (MILLIONS OF DOLLARS)



of the U.S. Department of Agriculture and the State agricultural experiment stations. All groups were asked to report separately as to the emphasis placed on basic research, applied research, and engineering and development. The comparative values are shown in table 2.

As one might expect, industry puts less emphasis on basic research than it does on engineering and development. In contrast, the emphasis in public agencies is just the opposite. It is encouraging to note that the projection to 1975 indicates that basic research may be modestly increased. The sharing of efforts in all types of research will apparently continue, despite the absence of any agreement or

[2] A report issued jointly by the National Association of State Universities and Land-Grant Colleges and the U.S. Department of Agriculture, October 1966. Definitions and classifications of research used in this article are the same as those used in the aforementioned report.

TABLE 2.—*Comparative emphasis on basic research, applied research, and engineering and development*

Categories	Industry		USDA and State experiment stations	
	1965	1975	1965	1975
	Percent	*Percent*	*Percent*	
Basic research	9	12	41	To be increased.
Applied research	50	49	56	Moderate reduction.
Engineering and development	41	39	3	Stay at same level.

understanding between industry and the public research agencies.

In this national study of agricultural and forestry research programs in the United States, the entire research effort was examined from three points of view: field of science, type of activity, and commodity categories. The comparative emphasis on general fields of science by industry is shown in table 3.

Note that industry is concentrating on the physical sciences and the governmental agencies on biological sciences, thus providing more complete coverage jointly than would otherwise prevail.

All three types of organizations devote relatively little effort to the social sciences, and most of this is on economics. Although the agricultural sciences might be expected to have significant orientation toward meeting the needs of people, there is little effort being directed toward people themselves. The projection for 1975 anticipates but little change in emphasis. Industry plans to continue its major emphasis on physical sciences.

Classification of all agricultural research by industry according to types of activity appears in table

TABLE 3.—*Comparative emphasis on general fields of science for agricultural research*

Field of science	1965			1975 (est.)
	USDA	State stations	Industry	Industry
	Percent	*Percent*	*Percent*	*Percent*
Biological	55	78	31	33
Physical	35	14	67	59
Social	10	8	2	4

TABLE 4.—*Activity emphasis in industry's allocation of research and development resources*

Type of activity	1965	1975 (est.)
	Percent	*Percent*
Conservation	4	3
Protection	26	27
Efficient production	26	24
Product development and processing	35	27
Efficient marketing	3	4
Human nutrition	4	4
Human resources	.....	1
Evaluation of public programs, and other	1	1
Total	[1] 99	[1] 91
Total expenditures for 459 companies	$448 million	$681 million

[1] Discrepancies in these data are due to partial omissions in some reports submitted.

TABLE 5.—*Commodity emphasis in industry's agricultural research effort*

Commodity	1965	1975 (Est.)
	Percent	*Percent*
Soil and water	1	2
Forest products	14	10
Crops	28	28
Animal and animal health products	15	16
Farm supplies and facilities	34	30
Human resources	2	2
Other	6	5
Total	100	[1] 93
Total expenditures (estimated for 459 companies)	$448 million	$681 million

[1] Discrepancies in these data are due to partial omissions in some reports submitted.

TABLE 6.—*Character of interest and total research and development expenditures by industry*

Type of interest reported by companies	Number of companies	R. & D. expenditures	
		1965	1975
		Million dollars	*Million dollars*
Agricultural economics	2	0.2	0.3
Biologics	7	2.8	4.9
Biologics and chemicals	12	14.0	23.2
Chemicals	49	35.3	52.0
Chemicals, feed, food, pesticides, and fertilizers	35	35.8	67.4
Cotton and textiles	2	2.3	8.3
Feed	9	1.9	3.1
Food and feed	13	15.4	22.2
Food	47	29.4	49.2
Food and other	11	20.0	28.6
Forest products	17	28.7	40.7
Machinery	8	36.2	50.8
Seed	15	7.6	12.5
Tobacco	4	2.9	5.3
Unclassifiable	16	14.7	38.6
Totals	247	247.2	407.1

4. From this viewpoint, industry is emphasizing plant and animal protection, inputs related to more efficient production, and product development and processing.

When industry's total research activities are classified according to the type of commodity, the emphasis is on crops, farm supplies, and facilities, with lesser investment in forest products and animal and animal health products, as shown in table 5.

In general, it is evident that industry collectively expects to sharply increase the level of research effort by 1975, but plans to maintain about the same distribution of effort in fields of science, types of activity, and commodities as it did in 1965. Perhaps this qualitative aspect of research and development should not be regarded as being as firm as the estimates of dollar increases from 1965 to 1975. The rapid advances now being made in science and technology may influence the kinds of future research in ways not readily foreseen in 1965.

The major interests of the 247 companies that reported their primary categories of agricultural research permit further analysis of the relationships between kinds of companies and the character of the research and development activities (table 6). These companies plan to increase their research and development support very substantially by 1975—an average of 64.7 percent. The major research thrusts in the agricultural industry seem to be in chemicals, foods, forest products, and machinery. Biologics and feeds are receiving less support than indicated in table 5 under the item—animal and animal health products. Since most agricultural industries are becoming more and more diversified, these relationships should not be interpreted too narrowly.

Further data analysis of the information supplied by industry respondents shows the research characteristics of four predominant groups of agricultural industries—chemicals, foods, forest products, and machinery (table 7).

Perhaps the most surprising feature of research on agricultural chemicals is the dominating position of protection of plants and animals. Efficient production, which involves large amounts of fertilizers and lime, apparently does not require as much research as that needed on chemicals for plant and animal protection.

In analyzing the research efforts of companies predominantly concerned with foods, product development and processing receive the major research attention. The same situation prevails with forest products companies. Machinery companies are devoting a high percentage (82 percent) of their research effort to production. As would be expected, food companies apply more research effort directly to crops, animals, and animal products, since these are the sources of foods.

It would be interesting to relate research expenditures by categories to total sales volume, but no such data were collected in this study. However, with the help of data from the U.S. Bureau of the Census, such a comparison is possible for one category—farm machinery. Here, research expenditures by manufacturers in 1965 were roughly 0.8 percent of the total spent for machinery by farmers, family autos and trucks excluded.

A comparison of research expenditures with farm income shows that Federal and State agencies invest an amount equivalent to about 1 percent of the total cash receipts of farm marketings; industries invest slightly over 1 percent.

Agricultural industry is primarily concerned with commercial agriculture, and generally does not invest in research for other aspects of the rural scene that are outside of commercial operations. Those

businesses and industries concerned with development and management of natural resources such as water, roads and highways, power, communications, construction of public buildings, finance—these are not classified as being in the field of agriculture. Of course, such companies do operate in the rural scene and have significant but indirect effects on commercial agriculture. However, the information presented in this article should be evaluated in terms of commercial agriculture—not as a total view of the rural economy.

Conclusions

COLLECTIVELY, the private sector appears to be conducting about one-half of the total national research effort in support of agriculture. This research is largely concerned with commercial agriculture, rather than other aspects of the rural scene.

TABLE 7.—*Research characteristics in four types of industries in 1965*

Classification	Chemicals	Foods	Forest products	Machinery
Fields of science:	*Percent*	*Percent*	*Percent*	*Percent*
Biological	36	51	3	1
Physical	63	47	63	99
Social	1	2	2	.....
Total	100	100	[1] 68	100
Activity:				
Conservation	3	4	14	1
Protection	66	12	1	1
Efficient production	14	22	8	82
Product development and processing	13	53	41	16
Efficient marketing	2	3	3	.....
Human nutrition	1	5	.....	.....
Human resources	.....	1	.....	.....
Evaluation of public programs, and other	1	.....	1	.....
Total	100	100	[1] 68	100
Commodity:				
Soil and water	1	3	1	1
Forest products	4	8	66	1
Crops	10	61	.....	4
Animal and animal products	4	15	.....	3
Farm supplies and facilities	68	5	.....	91
Human resources	.....	1	.....	.....
Other	1	7	1	.....
Total	[1] 88	100	[1] 68	100

[1] Incomplete information on some reports.

Agricultural research conducted by industry tends to complement that conducted by Federal and State governmental agencies. Industry-supported research places much greater emphasis on engineering and development, and substantially less emphasis on basic research. All agencies are devoting 50 percent or more of the total research and development effort to applied research.

Agricultural industry plans to increase its total research effort by about 65 percent by 1975, in roughly the same categories as reported in 1965. A small but significant increase in basic research is forecast. Although a comparable figure for projected increases for Federal and State agencies was not included in the original study, an analysis of the projected scientist-man-years reveals that the percentage increase of public research effort is expected to be about the same as that of industry. Allowances must be made, of course, for dollar availability, since no one can tell what area or kind of public fund support may be desirable or necessary at a given point of time in the future.

The total agricultural research effort by industry tends to emphasize chemicals, foods, machinery, and forest products. Chemical research relates most strongly to protection of plants and animals, and is reported in the category of farm supplies and facilities. Food research relates most strongly to product development and processing, with secondary emphasis on efficient production. This is reported under the commodity categories of crops, and animals and products. The forest products research is predominantly concerned with product development and processing, and secondarily with conservation and efficient production. Machinery research is mostly concerned with efficient production; it appears in the category of farm supplies and facilities.

An evaluation of the agricultural research supported and conducted by the private sector provides a more valid estimate of the strength of American agriculture than has previously been available. This knowledge may be important in projections into 1975, both for national agricultural development and for foreign programs.

Safe Use of Feedlot Hormones

DIETHYLSTILBESTROL (DES) is a potent female hormone (estrogen) produced by chemical synthesis and used to fatten cattle in feedlots. Over 90 percent of the compound is excreted practically unchanged as manure which often is used in truck farming. Because of the possibility that the potent estrogen may be absorbed by plants and become part of the human food chain, scientists at the Colorado Agricultural Experiment Station set up a project to determine the fate of DES when feedlot excreta is used as fertilizer. The project was operated cooperatively between scientists in the Departments of Biochemistry (M. L. Hopwood) and of Botany and Plant Pathology (Robert G. Hacker).

Excreta were collected from a steer before and after administration of DES labeled with radioactive carbon to identify the material or metabolites of the material at extremely low levels (parts per billion). Radish, pinto bean, wheat, onion, and lettuce plants were grown in a greenhouse in pots containing two soil types (acid, alkaline) and manure from the steer. The plants were harvested and the soil and parts of the plants were analyzed for radioactivity. In addition, the estrogenic potency of the material in soil or plants was determined by bioassay in immature mice.

Radioactivity was found in all plant parts regardless of the soil in which the plants were grown. The radioactive material in the plants did not behave like estrogen except in lettuce roots and radish leaves grown in alkaline soil. An acid soil environment destroyed the DES completely, but the alkaline environment removed only two-thirds of its activity as an estrogen. There were differences in metabolites among the two soil types. Little of the radioactivity was leached from soil, and plants removed only traces of the radioactivity in the soil. Fungi and bacteria growing in the soils were capable of metabolizing DES and some species could employ it as a sole nutrient. There does not appear to be any hazard to human health from using feedlot excreta to fertilize edible plants.

From *Research Serves Colorado,*
79th Annual Report,
Colorado State University

NATIONAL HOME ECONOMICS SEMINAR

A Special Report

APPROXIMATELY every 20 years since the passage of the Hatch Act, certain readily identifiable landmarks have characterized the progress of home economics research in the United States. The most recent of these landmarks was the National Seminar and Workshop for Home Economics Research Administrators held at the University of Nebraska April 5–7, 1967. Such was the appraisal voiced by one of the participants—Dr. Catherine Personius, formerly Coordinator of Home Economics Research, New York State College of Home Economics, Cornell University. And if one can evaluate the merit of her statement on the basis of the quality of the planning and thinking that this seminar engendered, then a landmark it was—destined to be as significant and far-reaching as any of the previous ones.

The primary purpose of the seminar-workshop was to identify home economics responsibilities in the implementation of the long-range research program resulting from a joint study [1] by State agricultural experiment stations and the U.S. Department of Agriculture. A series of talks by nationally-known scientists pinpointed the contributions that home economics could make to each of the study goals. During the workshop sessions, participants further considered the goals and projections in relation to problem areas, personnel, and other resources.

In attempting to summarize this conference, the staff of *Review* was faced with the arduous task of sifting through nearly 300 manuscript pages of text, tables, and graphs. In the interests of brevity, we are confining this summary to a discussion of the critical issues raised by some of the speakers and an enumeration of the goals which home economists have set for themselves in trying to earn recognition and acceptance as a distinct segment of the national scientific effort.[2]

It seems unmistakably clear that home economics research administrators realize the pressing need to strengthen their current research programs and to initiate new lines of work. As Dr. Gwen Bymers,

[1] "A National Program of Research for Agriculture," Report of a study sponsored by the National Association of State Universities and Land-Grant Colleges and the U.S. Department of Agriculture, October 1966.

[2] Readers who are interested in obtaining a copy of the complete proceedings of the conference should address a request to Dr. Mary Beth Minden, Cooperative State Research Service, U.S. Department of Agriculture, Washington, D.C. 20250.

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Cornell University, said: "There may be some real payoff in research projects that seem to be breaking out of traditional molds." Although research will undoubtedly continue on the material aspects of living—food, shelter, and clothing—an increasing concern is developing for the behavioral and social aspects which will lead to an improved quality of living.

Housing Research

IT is interesting to note how this change of emphasis may affect traditional lines of research. Take housing, as an example. Fifteen years ago farm houses were designed to meet the needs of the full family cycle, according to Dr. Murlin Hodgell, University of Nebraska. Today some of those same houses have been abandoned as a result of the farm consolidation process. In the 1950's we equated "rural" with "farm" and largely ignored the needs of the majority of rural people who live in rural villages or other nonfarm locations. Too much research money was spent on middle-class problems to which the researcher could personally relate and for the benefit of a class of farm people who were relatively capable of taking care of themselves.

Dr. Hodgell pointed out that, in housing studies for any particular region, the total context should be the effective community. Housing has little permanent meaning except as an interrelated aspect of total environment—which involves schools, markets, transportation, recreation, and job opportunity and satisfaction. The presence of a junkyard across the road, for example, may have more bearing on the livability of a house than on internal space design. The location and quality of the public school is a far more significant factor in environmental design than are questions of maintenance for bathroom services.

This revised approach, Dr. Hodgell believes, adds community evolution to family cycle and recognizes that housing is only one physical aspect of the complex pattern of today's life. This new focus also recognizes that the economics of the home are determined by the economics of the community and the region and are hopelessly intertwined with those broader factors. Under such a concept, spending research money for, say, comparisons of kitchen work surfaces would carry a low priority in the face of needs dictated by a new social consciousness.

Textiles and Clothing Research

NEW concepts are also identifiable in textiles and clothing research. Dr. Ruth Galbraith, University of Illinois, expressed disagreement with the belief that, since a large segment of the textile industry is not agri-related, home economics and agriculture do not have a stake in the industry. She theorized that Americans buy much of their clothing for social reasons and that social judgments are made on the basis of the clothing people wear. She pointed out, however, that little is known about how cultural patterns of living affect clothing preferences. Consequently, since home economists are not able to tell the textile industry what consumers would like to have, they cannot help the industry give better consumer satisfaction. Therefore, one of the major research problems in this area is the development of a way to determine why people make the choices they do. Thus, motivational research will aid not only clothing research but also home economics research in other areas where cultural values affect economic choices and social behavior as well as meeting physical needs.

Because the textile industry is so important to agriculture, home economics research has an obligation to do basic research on fabric performance and consumer preferences—areas now neglected by the textile industry. The home economics profession might best fulfill a dual responsibility to consumers and agriculture by searching for ways in which agricultural fibers can make their maximum contribution to blended fabric properties.

One of the major problems in textile-clothing research, Dr. Galbraith believes, is that textile technologists and consumers don't talk the same language. Furthermore, home economists have not developed a method of reaching all consumers with new consumer information.

Improving Family Living Conditions

ONE theme that conference participants kept driving at again and again was that the research focus on the family needs to be redirected. The chief reason for this need, according to Dr. Personius, is that the family as a social unit has declined in prestige because of the complexity of modern society. She quoted other authorities who believe that at one time the family was "a fine mechanism for trans-

mitting knowledge and wisdom in a relatively static society." But in our rapidly changing modern world the family is doing a relatively poor job in transmitting new knowledge needed by the younger generation.

Dr. Glenn R. Hawkes, University of California, Davis, challenged home economists to push strongly for the strengthening of families so that their educational potential can be exploited. He noted that our reforms to date have been mostly in the formal educational system. Little has been done to facilitate education through the family—a potentially effective educational institution.

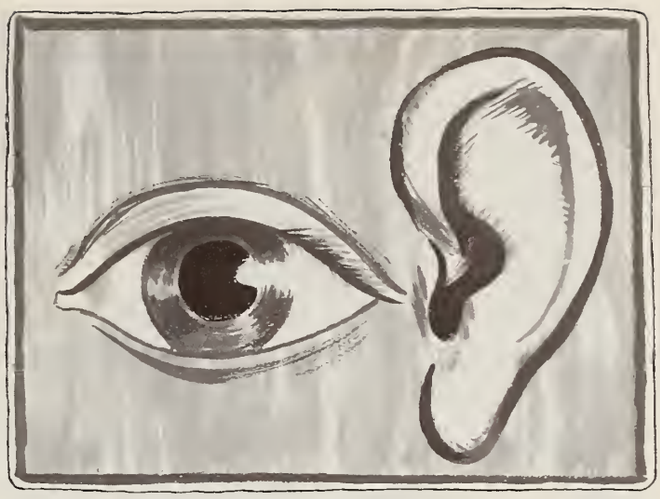
Dr. Hawkes charged that, as far as the behavioral science goals in agriculture are concerned, several distinct research needs are clear.

1. "We do not understand the characteristics of the rural farm and nonfarm poor; nor do we understand the characteristics of those rural poor who have become urban dwellers. Demographic studies of these characteristics are sorely needed. Most of us who are researchers, being steeped in middle class traditions, cannot understand the living conditions of these people until we see them. We must adopt the practice of the social worker and go where the people are in order to understand.

2. "We are becoming increasingly aware of the interrelationships of human development and the family. Research in early learning deficiencies has indicated repeatedly that a restrictive family environment does have a strong impact on human development.

3. "The needs of families who live in physical or psychological isolation are not well understood. Those people who migrate from rural to urban areas often find themselves more a part of 'the lonely crowd' than those who have retained their identity in their previous milieu. This type of isolation is not understood. New strategies to help understand it must be developed. There seems no choice but to more effectively utilize the skills of the behavioral sciences and to find ways to enhance communication across discipline lines.

4. "Diverse population groups must become an integral part of our studies. An examination of traditional research—particularly family relationships and child development—shows that, by and large, we have drawn our generalizations from middle class populations. This, undoubtedly, was a legitimate beginning for our research. These populations



were available to us; our expertise was so limited that this did not seem to be the problem that it has now shown itself to be; and financial support was so limited that it was impossible to go to where the people were. Today, however, if we are to be of service in helping to meet the national goals, we must have the resources necessary to explore different population groups.

"At one time, undoubtedly, the agricultural community involved primarily the small farm operator who was production oriented. Today if we see agriculture in its totality, we must be aware not only of the farm family, but also of farmworkers, the rural nonfarm person, and the impact of this rural population on the urban areas. I have long championed the belief that differences between rural and urban people are not as great as some would have us believe. I have also suggested that the interrelationships between the rural and urban people could be more effective if we would divorce ourselves from this artificial dichotomy which seems to have been a political safeguard.

5. "We must find the processes which facilitate change adaptation in some families and those processes which discourage it in others.

6. "An experimental program would help establish the efficacy of some of our generalizations about human development, the family, and the community. Certainly these three factors are closely interrelated. Separating them is artificial, serves to perpetuate academic isolation, and in no way suffices for "real living conditions." This experimental pro-

gram would undoubtedly call for total involvement in human welfare."

This same theme of improved human welfare was stressed by the keynote speaker at the conference, Dr. T. C. Byerly, Administrator, CSRS. He emphasized especially the need for home economists to delve into problems of family economics—particularly in relation to disadvantaged families. In typical fashion he expressed his philosophy in a series of hard-hitting questions—each of which might well represent a legitimate area of research.

"In this era of Keynesean economics and worship of the exponential growth of the gross national product, is thrift dead? How the family uses its resources, what it gets for the money it spends is surely as important as the amount of available resources, within very wide limits. The problem is aggravated by the fact that the poor pay more. How do families on welfare establish credit? How can they take advantage of quantity discounts? How can they use the fact that cheap is not necessarily economical? Are these problems researchable or only copybook maxims? What responsibilities have home economists? Are they so middle class that these questions are considered trivial or insoluble? Are they researchable?"

Improved Efficiency of the Marketing System

A PLEA for a redirected emphasis in the marketing economics area was outlined by Dr. James D. Shaffer, Michigan State University. Among other suggested research priorities, he cited the need for knowledge about consumer practices that add unnecessarily to marketing costs—practices of one consumer which harm another. Typical examples are: spoilage of certain fruits and vegetables because consumers insist on squeezing them, preferring trading stamps to price reductions, and "taking advantage of the insurance company." Dr. Shaffer stated emphatically that the home economist has a legitimate interest in attempting to identify, understand, and correct these practices.

He questioned the attitude of the home economics profession in being reluctant to search for knowledge contributing to improved consumer wants and values.

"Our society," he said, "has failed to achieve its potential quality partly because we put all our research emphasis on improved means to obtain unimproved wants."

In an earlier era, he noted, home economists contributed much to the improvement of our society by aiding us in developing wants for such things as improved sanitation and nutrition. Now, research is needed to discover the wants which, when fulfilled, would lead to a higher quality of life. The payoff could be very high.

Human Nutrition

DESPITE the present wealth of knowledge on human nutrition, the great frontiers in nutrition research today are extremely varied and numerous, according to Dr. Clara A. Storvick, Oregon State University. She cited a list of perplexing questions to which nutritionists seek answers, and implied the magnitude of the problems by commenting: "It is on these distant stars that the nutrition worker has his eye."

- By what means can the protein needs of developing countries be met?
- What are the factors during aging that affect the biosynthesis or degradation of cholesterol, demineralization of bone, loss of body protein, and degeneration of muscle tissue?
- What are the normal pathways for the metabolism of carbonhydrates, fats, and amino acids? What factors alter these pathways?
- How can diets be devised for those who have inborn errors of metabolism?

Communication, Coordination, and Training

THREE aspects of home economics research activity—communication, coordination, and training—were repeatedly cited as areas that need strengthening.

A need for more effective communication was recognized not only among researchers in related disciplines, but also between home economists and consumers.

Successful methods of communicating with low-income families are especially needed, according to Dr. Faith Clark, U.S. Department of Agriculture. She called for more research to test the effectiveness of different types of communication—mass media, bulletins, group meetings, personal consultation, and other.

Dr. Clark also stressed the importance of good reviews and evaluations of existing research—an area of communication that has apparently been somewhat neglected.

Assistant Secretary of Agriculture George L. Mehren challenged home economists to make greater efforts in coordinating their research activities at all levels. Methods must be found, he said, for improved communication among all individuals and agencies so that talents with common interests may be coordinated to focus on the larger problems.

He also challenged them to make respectable use of their talents in the service of humanity, and expressed concern over the practice of quibbling as to whether a given piece of research is basic or pragmatically oriented.

"Any research," he said, "can be designed to serve social or other needs, can conform fully to accepted scientific method, and can be purposeful in outcome. Meaningful applied research needs no apology."

Dr. Mehren concluded that, if home economists hope to meet the projections of the National Program of Research in Agriculture, they must develop a sense of urgency for research focussed on family and consumer needs.

Dr. Pauline Paul, University of Nebraska, spoke out strongly for more attention by administrators to the problem of inadequate staffing of home economics departments. She implied that one of the causes might be that young people who are potentially capable as home economics researchers may be reluctant to "join a loser."

Home Economics in Foreign Aid

HOME economics administrators are becoming increasingly aware of the contributions their discipline can make to the problem of hunger in developing countries.

"Our policies and our assistance programs," stated Miss Trienah Meyers, U.S. Department of Agriculture, "must be directed toward its solution—for humanitarian reasons as well as in our own self-interest. In the first place, it is morally impossible for us to accept widespread hunger and suffering when we know that it it scientifically and physically possible to produce enough for all."

Actually, there is no shortage of problems to research, Miss Meyers pointed out. But there is a

shortage of knowledge on how to adapt our research to other cultures. Moreover, there is a shortage of people in the United States who are not only talented in their own discipline but also sensitive to the need for relating to other disciplines.

Dr. Lura M. Odland, University of Tennessee, cited the need for greater cooperation among all agencies concerned in foreign assistance. Some of the past difficulties, she said, have arisen from the fact that many programs have been sporadic, *ad hoc,* and inadequately related to each other.

Challenges and Recommendations

RECOMMENDATIONS and assignment of priorities for the long-range research program appear in complete detail in the proceedings of the conference. However, certain salient points seem to summarize the goals and challenges home economists have set for themselves in broadening their role in the national scientific effort. These points, which are enumerated below, were contained in an earlier report to the Experiment Station Committee on Organization and Policy—as presented by Dr. Margaret Hard, Washington State University. Dr. Hard served as chairman of the conference planning committee.

1. Researchers must have strong, sound bases in arts and sciences as well as depth in specialization. All possible steps will have to be taken to encourage capable young people to adequately prepare themselves for research positions in the future. The projections for personnel will require attention of administrators and faculty to inspire undergraduate and graduate students to prepare themselves with all possible speed for the opportunities that will clearly be available to them. New generations of scientists must be trained.

2. Home economics research will need to take steps to enhance present competencies in all possible ways to become more effective in leadership positions. Research faculties must be enlarged and strengthened. Quality and effectiveness of research productivity can be no better than the scientific community of which home economics is a part.

3. Home economics administrators will have to take greater responsibility in encouraging faculties to realize the importance of research and to take steps to provide time for doing research along with teaching. Release time for research will need to be an integral part of a staff member's appointment.

4. Administrative support is imperative. Qualified research projects must be expediently processed and supplied with adequate initial and continued financial support.

5. Closer coordination is required between research, teaching, and extension. Home economics researchers will need to find ways to coordinate all possible interests in the research project—university, government and industry. Greater emphasis needs to be placed on cooperation with industry.

6. Research is an intellectual quest for knowledge. Administrators have the responsibility to protect the freedom of the individual research worker or student from outside pressures that might hinder this freedom.

7. Strong research programs develop when a university has special competencies in a certain field of endeavor. Each must assess its own programs, evaluate its strengths, and be willing to set forth priorities. Not all can have centers of excellence in all areas.

8. Vigorous and imaginative approaches to interdepartmental cooperative research need to be encouraged and implemented. Home economists have been modest about their past accomplishments. They talk too much to each other and not enough to other scientists.

9. Research results kept in the files of scientists add nothing to public knowledge. There is an urgency to publishing proven results without delay. Too often overlooking or delaying publication adversely affects progress in the discipline.

IDENTIFYING CREATIVITY In Research Scientists

R. J. SHAPIRO

ACCORDING to the spate of research reports on creativity during the past 15 years, there is a growing awareness of the need for establishing methods of identifying potentially creative young scientists. The particular emphasis on scientific creativity can probably be attributed, in part, to the urgencies of the space age and its attendant problems.

From an applied point of view, however, developing instruments for predicting creative research performance presents a big challenge. Despite the extensive work expended on constructing tests currently in use, their efficacy remains in doubt; few methods show promise.

Unfortunately, many researchers have used available tests without attempting to validate them—a condition due less to methodological carelessness than to the sheer difficulties inherent in any attempt at validating creativity. Setting up objective criteria of creativeness is at least as imperative as formulating predictive methods.

On this premise, therefore, a study was initiated [1] in which an attempt was made to identify creative research scientists by developing a battery of tests and finally applying them to a group of research workers. The resulting predictor scores were correlated with measures obtained from several independent criteria of creative ability.

Choosing the Subjects

SEVENTY-four subjects were obtained from various institutes of the Council for Scientific and Industrial Research (CSIR) and the South African Institute for Medical Research (SAIMR). Participation was voluntary. The fact that only 6 of the 80 originally contacted dropped out insured that a representative range of ability was obtained. Two subjects were omitted in the final compilation of data because they did not complete their tests.

All subjects were English-speaking males, employed by their institutes on a full-time basis, and

[1] Witwatersrand University, Johanneshurg, Republic of South Africa.

This article was condensed from *Psychologia Africana*, vol. 11, No. 2, 1966, and is puhlished with the approval of the National Institute for Personnel Research, South African Council for Scientific and Industrial Research.

engaged in research work. Age range was 23 to 46 years; experience ranged from 1 to 25 years. The majority had degrees beyond the bachelor level. Nine fields of research were represented, the highest numbers being from chemistry and medicine.

Designing the Tests

THE battery of tests was designed to measure five factors of creativity: originality, ideational fluency, sensitivity to problems, integration of remotely associated concepts, and sensitivity to implications.

1. *Originality—the ability to produce uncommon, novel, or clever answers.*
   Three tests of originality were used:
   a. *Consequences*
      Subjects were presented with hypothetical and unlikely happenings and were required to respond with possible consequences of such happenings. Example: What would be the consequences if the sun never rose again? Originality was measured on the basis of the statistical infrequency of responses. Answers occurring only once—provided they were not incorrect or inappropriate—were given a weight of two points. Answers occurring twice received a weight of one; those occurring more frequently than twice were not given credit.
   b. *Product improvement*
      This test required subjects to think of different ways for changing a toy dog so that children would have more fun playing with it. Scoring was similar to that for the consequences test.
   c. *Impossible situations*
      Subjects were asked to describe an imaginary day in the life of an invisible man or a person having the power of controlling other minds, and to imagine typical dreams that Hitler and Casanova might have had. Three judges independently rated the answers on a 9-point scale of originality. Thereafter, they discussed each one and agreed on final scores.
2. *Ideational fluency—the ability to produce ideas where quantity and not quality is emphasized.*
   a. *Color*
      Subjects were given 5 minutes to write down the names of as many things as they could that are always, or nearly always, white in color. The total fluency score was the sum of the number of acceptable responses.
   b. *Shape*
      Subjects were given 5 minutes to write down the names of as many things as they could that are always, or nearly always, pointed in shape. The same scoring procedure as above was used.
3. *Sensitivity to problems—the ability to recognize problems when they present themselves.*
   This test consisted of four parts, each of which described a solution to a particular problem. Subjects were given 5 minutes to name all the faults or weaknesses in the proposed solutions to the four problems.
4. *Integration of remotely associated concepts—the ability to discover a feature common to two or more apparently unrelated concepts.*
   This process has been regarded by many as the essential characteristic of creativity. Two tests measured this ability.
   a. *Common properties*
      Subjects were required to find some common feature between 20 pairs of objects that have no apparent relationship, *e.g.*, book . . . acorn.
   b. *Common activities*
      This was a similar test except that it consisted of pairs of apparently unrelated activities. For both tests, acceptable answers were each given a score of one.
5. *Sensitivity to implications—the ability to detect implications in a problem or anomaly.*

Criteria from a variety of sources led the author to hypothesize this ability. The rationale underlying the hypothesis is based on the belief by eminent philosophers that scientific discovery begins with the problematic situation, not with facts or theories. And this situation is not problematic until there is something in it that is disturbing. In other words, creative thinking consists in being sensitive to that disturbance, in staying with it and analyzing it, and finally coming up with some kind of speculative answer confirmed by empirical or experimental evidence.

Chance happenings can lead to new insights, but

only for "prepared minds." In terms of the author's hypothesis, the prepared mind is one that senses implications in the chance observations. Thus, a sensitivity to implications will show itself, not only in rare instances of serendipity, but in numerous less dramatic incidents. A number of scientists may all be fully aware of a problematic or anomalous situation existing in their field, yet not all will be disturbed into sensing that the anomaly contains perhaps far-reaching implications. To take a familiar example: Most people had long been aware of the peculiarity that a pet may salivate in response to a stimulus preceding, but associated with, its food. Yet it is a mark of his creativeness that Pavlov should have grasped the implications of such an "anomaly."

In everyday research the ability of sensing implications may be revealed as the ability to generate hypotheses. For this reason the author devised a test requiring subjects to propose hypotheses, and it was intended to thus gain a measure of sensitivity to implications.

The test consisted of four items, each describing a hypothetical and unusual phenomenon (anomaly); for example, during a particular 2-month period not a single athlete manages to run the mile distance in less than 7 minutes. Subjects were required to propose hypotheses which, if tested, might explain the unusual phenomenon. Seven minutes was allowed for each item. Each acceptable response was given a score of one, but incorrect answers, similar responses, and duplications were not given credit.

Establishing Criteria

THE problem of the criterion, in essence, is simply the problem of how to identify the creative person or how to identify the creative worth of the products of an individual. This represents the most challenging aspect of research into creativity. Without establishing objective criteria, all endeavors at devising predictors, investigating personality and cognitive characteristics, and venturing hypotheses about the creative process—these are of questionable value.

For this study, criteria were constructed to cover several areas of information, and ratings were obtained both from supervisors and from the subjects themselves. Criterion scores were obtained on a work-habits inventory and a personality questionnaire. Additional information was obtained from a products questionnaire and a biographical questionnaire. To prevent subjects from being influenced by their performances on the predictors, all ratings were made several days before testing subjects on the predictor battery.

1. *Work Habits*

Eleven criterion ratings were constructed on the basis of the work habits originally proposed by Sprecher.[2]

1. The production of novel (original) ideas
2. Energetic work activity
3. The production of many solutions to problems (fluency)
4. Self sufficiency (independence)
5. A tendency for analyzing problems or data thoroughly
6. A liking for difficult and unusual problems
7. Careful planning of research
8. Skill in verbal communication with others
9. Perseverance
10. Technical and theoretical competence
11. Success in personal relations.

Each work habit was described in terms of three statements that referred to readily observable activities. In addition to these 33 statements, 7 additional statements, which the author believed to have no importance or possibly negative importance for creative ability, were added.

1. Punctuality
2. Obedience for authority
3. Attention to details
4. Careful following of instructions
5. Tendency not to question those with superior knowledge
6. Modesty
7. Neat and systematic work.

Ten well-known senior research scientists were asked to rate the statements as to their importance to creativity. All of these judges had displayed innovative ability in their own accomplishments. Each had worked with or knew personally other scientists acknowledged as eminently creative; five had worked closely with Nobel prize winners.

They recorded in plus, minus, and zero columns whether they believed each statement to be important for creativity (plus), possibly important (zero), or not at all important (minus).

[2] "A Proposal for Identifying the Meaning of Creativity," T. B. Sprecher. In: *Scientific Creativity*, C. W. Taylor and F. Barron, eds. New York, John Wiley, 1963.

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Only 25 of the 40 statements received plus ratings from 6 or more judges; therefore only these 25 statements are regarded as important indicators of creativity (table 1). None of the statements refer-

TABLE 1.—*Work-habit statements judged to be important for creativity*

Work habit	Statements receiving 6 or more plus-ratings from judges	Actual plus-ratings given by judges
		Number
Novel (original ideas)	Tends to develop new ideas	10
	Tends to develop original approaches to problems	10
	Tends to think of novel solutions to problems	10
Energetic work activity	Keeps up a fairly vigorous activity level	6
	Usually is able to work harder than most	6
	Tends to carry out his work energetically	7
Many solutions (fluency)	Seems to have many ideas for any given problem	9
	Thinks of a lot of solutions without difficulty	9
	Thinks of a lot of ideas to get something done	9
Self sufficiency	Is able to reach a decision on his own	8
	Does not require continual pushing and assistance	9
Analyzing	Breaks a problem down into all its elements	7
	Considers every angle of an involved problem	9
	Analyzes his data to take account of all factors	7
Likes problems	Likes to work on unusual and challenging problems	8
	He likes dealing with difficult problems	8
	Is willing to try to solve a difficult problem	9
Plans	Plans carefully when considering a problem	6
	Plans what he has to do before doing it	6
Perseverance	He is not easily distracted from his work	8
	Would keep at a problem until it was finished	8
	Does not give up easily in working on problems	9
Technical and theoretical competence.	He surpasses others in grasping the fundamental concepts of his field	10
	Stands out because of his technical or theoretical knowledge	6
	Knows what he is talking about technically or theoretically	9

ring to the other two work habits—skill in communications and success in personal relations—received as many as six plus-ratings. Furthermore, none of the seven additional work-habit statements included by the author was considered important for creativity.

All 40 statements of creativity and productivity inventory were used for the criterion form, and two identical sets were made—one for supervisory ratings and one for self ratings.

2. *Personality Characteristics*

Numerous studies support the idea that the highly creative scientist differs from the less creative one with respect to certain personality traits. A survey was made of virtually every study relating to creativity and personality. A total of 26 different traits collected from this survey formed the basis for a personality questionnaire. Both self and supervisory ratings were taken. An attempt was made to express the descriptive personality characteristics in a neutral fashion so that some did not necessarily appear more desirable than others. To some extent, this is not completely true of all the items, for the simple reason that certain traits (emotional instability, for example), though socially undesirable, nevertheless characterize the creative person and therefore had to be included.

3. *Products*

An inventory was designed to gain information about each scientist's output. Supervisors, who served as raters, were asked to fill in a products questionnaire for each subordinate they rated. Their task was to describe what they considered to be the best research achievement of each subject. Raters were also required to indicate the quantity and overall quality of each subject's total production.

4. *Biographical Ratings*

An item of the biographical questionnaire was designed to provide an additional rating of each subject's creative ability. A number of definitions provided a frame of reference for rating. Subjects then had to choose statements that seemed most accurate for themselves.

The Results

A PROMISING feature of the results is that all four crieterion measures correlate significantly with at least some of the predictors, although it is apparent that certain criterion scores are better in this respect than others. Personality ratings appear to be generally more effective than work habits.

There was definite evidence of validity for the battery of predictor tests used in this study.

On the basis of this study, it appears that scientists assess their own personal behavior and personality characteristics more accurately than do supervisors.

The findings tend to support the idea that there are at least quantiative, if not qualitative, personality differences between high and low scientists.

The more creative subjects appear to have a greater ability than the less creative subjects for integrating remotely associated concepts, and they are more sensitive to implications than are the less creative subjects.

Age bears little or no relationship with any of the predictors or criteria. Evidence suggests that in most fields of science workers reach a peak of creative productivity when they are 30 to 40 years old.

Numbers of years of research experience is not related significantly to any of the predictor or criteria measures.

Although there was a lack of correlation between intelligence and creativity scores, it may have been due to the fact that the sample was a fairly, high-level group with a relatively narrow range of intelligence scores.

Evaluation of Research Findings

ONE of the primary goals of this investigation was the construction of effective predictors of creativity, based on previously identified, as well as newly-hypothesized, cognitive factors of creative thinking. The high positive correlations obtained between scores on the predictor tests, and between predictor scores and the criterion scores provide evidence for the validity of the test battery designed to identify creative subjects. Despite the positive results obtained with the battery of predictors, certain reservations concerning the tests must be considered.

The main drawback is that the measurement of divergent thinking necessitates an element of subjectivity in the scoring methods. Even where the actual scoring procedure is objective, a subjective assumption is made to the effect that the score so obtained provides a measure of whatever the test is supposed to measure. For example, the scoring of the ideational fluency tests (Qualities, Color, and

Shape) is straightforward and objective. Fluency is measured according to the number of responses made in a set time. However, the assumption that the number of responses produced in a fixed time represents a true measure of ideational fluency is hypothetical, however, much it appeals to common sense. Even more questionable is the assumption that originality can be gaged by weighting responses according to their statistical rarity of occurrence in a population. This is obviously a convenient and easy-to-quantify procedure, but it rests upon an assumption.

Whether or not creativity involves a general factor or several independent factors, the strong positive relationship between the tests of the predictor battery in this study has a practical consequence. It should be possible to select a few of the more promising tests (according to their correlations with the other measures) and use these in place of the rather extensive batteries of tests commonly used for assessing creative potential.

The criterion measures of work habits and personality characteristics have also shown promise. Every predictor correlated positively beyond the 1 percent level with at least one of the criterion measures. Nevertheless, these criteria suffer from certain methodological defects. Clearly it would have been desirable to use a single rater rather than many, or to have established the extent of rating reliability by gaining a second rating from the supervisors and subjects at a later date. Unfortunately neither procedure was possible for practical reasons.

Measurements for criterion purposes are made either on products or on person. The work-habits and personality ratings refer to persons rather than products, and this has the effect of reducing their value as criterion measures. Though there is evidence to support the fact that creativity is manifested in characteristic personality traits and work habits, accurate judgments of creative ability can only be made on an individual's actual output.

The finding that intelligence scores did not correlate significantly with scores on any of the predictors, and excepting the self ratings on personality characteristics, with none of the criterion scores, accords with similar evidence by previous workers.

Conclusions

AN overall assessment of the present investigation should be made in terms of the current state of research on creativity. Although a great deal of work has been done, particularly in America, research on creativity is still in its infancy. The developments in creativity research over the past 15 years influenced the approach adopted in the present study.

An attempt was made to construct effective predictors of creativity and a number of criterion measures were devised to provide evidence of validity for these predictors. The results have been promising. An initial challenge lay in the fact that many existing tests of creativity were found to be unsatisfactory, and the author is of the opinion that his attempts at constructing improved versions of existing tests, as well as newly-devised tests, have met with some success, as borne out by the results of this investigation. As noted earlier, few researchers have included criterion measures in their studies, and an attempt was made in the present investigation to provide evidence of validity for the predictor battery by means of correlations with several criteria.

It is the author's hope that this investigation may serve to stimulate interest in creativity research by demonstrating the importance of learning more about creativity, and by demonstrating that the complex and elusive phenomenon of creativity can be brought down to the "laboratory" level for purposes of scientific investigation.

RESEARCH OPPORTUNITIES

In Community and Human Resource Development

PAUL J. JEHLIK

RURAL sociologists are deeply concerned about the emerging problems in community and human resource development. This concern stems from a realization that two primary factors now characterize rural America: (*a*) rapidly changing social conditions that are forcing rural people, their communities, institutions, and services to make adjustments on a scale heretofore never experienced, and (*b*) the fact that rural America is expected to be home for nearly 60 million people in the very near future. And for many of them it will be the sole area and source of work, education, social, and recreational experience.

More than 15 million rural Americans are members of low-income families, representing nearly half of the Nation's disadvantaged families. Many of them live in dire poverty. About one-half of the people on farms are in the low-income group. As a result of this deficiency in our rural sector, our gross national product suffers an annual loss estimated at $4 billion.

Many rural Americans are disadvantaged because of a lag in economic, human, community, and area resource development. Increasingly complex technologies and demands for improved skills and managerial abilities are not making it easier for them to improve their well-being.

Oddly, the more socially and economically fortunate rural families are also finding their communities, institutions, facilities, and services inadequate to meet their personal and group needs under the impact of accelerating social change. If we accept this fact, we are concluding that all rural people are in serious need of whatever resources may be available to them as they seek to understand and manage their environment and to understand and

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solve the present and emerging social problems confronting them. In recognizing this, we are also saying that man is not, nor need he be, nor do we want him to be a slave of his environment or of his technology.

Why have the behavioral sciences lagged in providing scientifically validated knowledge to cope with this accelerating social change and its attendant problems? The answer commonly given is that the behavioral sciences are young. But this is only a small part of the explanation. We need to look for more valid causes.

One is that social phenomena are not only more complex but less stable, as reflected in the social changes taking place. Thus they are not as easily analyzed as physical or biological phenomena. Moreover, the technologies of the physical sciences are not adequate by themselves for analyzing social phenomena.

Another reason for the lag is that every pattern or system of human relations is reinforced by powerful sanctions of persons who believe they possess adequate understanding of these relations and do not need the aid of scientific analysis.

And third, every human personality is a stationary phenomenon only momentarily—a point of reference between memories, conscious or unconscious of the past, and expectations of the future.

These explanations illustrate some of the difficulties of the past and perhaps of the present. They need not and should not deter behavioral scientists from trying to satisfy the need for a maximum accumulation of behavioral science knowledge. Such reasoning can be assumed because certain principles, or combinations of forces, that govern human relations are just as important as those governing the construction of a bridge or breeding plants and animals. Behavioral scientists, therefore, need to work at the task of knowing these principles and of better understanding these combinations of forces. Many important social phenomena are too complex and too dynamic to be explained with the same degree of exactness as is possible with physical facts. But the scientific study of them will bring all gain and no loss. Behavioral science can seldom make accurate predictions, but it can state alternatives between which public and private agencies and their leaders can make intelligent choices.

The findings of behavioral science will probably never be either as exact or as influential as those of, say, physics or biology. Furthermore, they will not often be applied by engineers or other experts, but by common men who will synthesize and modify them by their common sense understanding of subtle local situations and conditions.

Dimensions of the Terms [1]

WHETHER we're talking about economic development, area development, human resource development—or whatever the scope might be—the term, *development,* suggests an effort or a series of alternatives toward helping people rebuild or reshape their environment—the social, economic and physical conditions and situations within which they live, learn, work, and play. The term also implies the concept of interdisciplinary problem identification and solving.

The point has frequently been made that society is in a revolution and that we are closer to its beginning than to its end. If this is true, then the task of developing and redeveloping our environment is certainly a major as well as a continuing concern of everyone. In community development, for example, a wide range of interests could encompass everything from social welfare and its many facets—including health, housing, sanitation, education, recreation—to city and suburban planning, industrial and business promotion, and college and university research and service to community programs.

The term, *community,* is often used rather loosely both in lay circles and in some professional circles. Usually, it means a geographic locale in which people share a sense of unity and common interests. Thus, a community may be a neighborhood consisting of a few families. It can be a trade center community made up of the people living in a sizable town or urban center and the surrounding countryside served by the town or center. Or, it can be a multicounty area or region in which people have one or more common interests or concerns at some given time. Such a dimension emphasizes locality.

The other dimension of the community emphasizes specialized interests whose linkages generally go beyond the community—for example, the relationship of the individual to some local interest

[1] Adapted from "Development Defined," by E. J. Niederfrank and Irwin R. Jahns. *Extension Service Review,* 37:3, March 1966.

group and that of the local interest group to a regional, State or national organization. A farm organization member, 4–H Club member, PTA member or a member of a civic organization would be a case in point.

The term, *human resources,* encompasses variables such as attitudes, aspirations, health, mental abilities, leadership, skills, knowledge, and various combinations of them. Development of both human and community resources is an interrelated matter and an interacting process. It involves goals, methods, and content of programs functioning as interacting forces.

Since the basic goals of social, economic, and human development may be expected to be always with us, community development will have to continue as a basic social action process. Thus, community development is more than a program. It is more than a concern with organizations and leadership. It is a technique for stimulating organized self-help by the democratic process. Although we are likely to think of development as being valuable because it makes more farm and nonfarm products and income available for human use, it, in fact, has an additional or more important product: It involves people bringing about a change in themselves and in their environment so that they can more effectively accomplish these goals. This effort may be qualitative or quantitative or both.

Scope of Current Research

THE program in community and human resource development currently consists of an average of about four projects per State. Most are concentrated in fewer than 20 institutions. Thus, little or no work is carried on in more than half of the States. Just over one project per State is being carried out in the poverty area. In general, the projects answer such questions as, *who, what, when, where,* and *how*. The more basic question, *why,* is yet to be researched vigorously.

Even though some of the first hypotheses about the process of community development were stated as early as 1921, the subject has not yet been studied empirically with sufficient intensity or depth to permit going beyond a number of hypotheses regarding the process.[2]

Basically, behavioral science research on rural communities over the past 20 years has been negligible. Only in the last 5 years has there been a regeneration of interest in this area. Particularly lacking has been the wide array of up-to-date studies needed as a foundation for community and human resource development programs in such areas as Appalachia, the Ozarks, the Intermountain region, the Cut-over, the South and wherever poverty exists in any concentrated form or, for that matter, for development purposes in many nonpoverty areas.

Some idea of the size of the job may be seen from the fact that about 10,000 organized communities in the United States are engaged in one form or another of community improvement and development. How many other communities are more or less dormant, or how many rural people do not readily identify with a community, or what potential community organization and development exists—these can only be guessed. How many public and private, formal and informal programs are underway without benefit of adequate research base likewise is unknown. Presumably, the number is rather large. Those who work in community development would feel much more comfortable and confident if this research were developed to the point that it would generate highly relevant generalizations and principles such as, for example, those regarding adoption of improved practices.

Researchable Opportunities

THERE are innumerable research opportunities in the area of community and human resource development. This fact we must acknowledge if we accept the premises that (*a*) rural people need to be better prepared to compete successfully in the labor market and (*b*) that an improvement in their environment could facilitate full and satisfying employment and living. The relationship between human development and culture as generated by communities and the society at large was well expressed by Montague when he wrote, "As human beings, we are creators of human beings, and we shall always have the kind of human beings among us that we make." [3] We "make" human beings by the process of socialization in which the individual is "taught"

[2] Edward Lindeman, *The Community*, Association Press, New York, 1921, ch. 9.

[3] M. F. Ashley Montague. *The Direction of Human Development: Biological and Social Bases.* Harper & Bros., New York, 1955, p. 291.

or learns how to behave towards others and the "nature of the world" in which he lives. The community and the family have very important roles in this process.

Wherever less-than-optimum conditions exist—whether it be Appalachia, the Ozarks, or an indigent village in the Midwest—then the question can obviously be asked: "What projects and plans can bring this area closer in line with national development?"

As a partial answer to this question, I propose some researchable behavioral science questions that have principal, though not exclusive, relevance to community and human resource development problems of disadvantaged areas. With slight modification, these questions likewise may be pertinent to other sectors of the population. In listing any set of questions, one needs to assume that an area or a region and a people are always in a process of development, and that many of their abilities remain potential for the future. For as the philosopher Heraclitus said: "Nothing is; everything is becoming."

The following questions should not be considered mutually exclusive nor totally inclusive; nor are they arranged in any order of priority.

1. Are the people of the Appalachia area, for example, willing to accept the consequences of a new economy whose benefits must be purchased at the price of some significant changes in an accustomed way of life?

2. What are the implications of the beliefs and values of the people in the Appalachia area—whatever they may be and in all their variations—for those who are actively working to promote social and economic change in the region?

3. What are the most relevant combinations of personal factors from among such characteristics as age, education, skills, adaptability to new kinds of employment, mobility, and attitudes that either tend to generate poverty or enable individuals and families to escape it?

4. What are the aspirations, motivations, values, and social standards of the disadvantaged? To what extent and in what respects are they similar to or different from those of the more fortunate segments of the population?

5. What is the rate of change a family, community or area can take and still maintain itself as a relatively orderly unit? Do the present rates and types of mobility contribute to family and societal goals and to satisfying adjustment of the children and youth in the new environment?

6. What are the effects of prolonged poverty (spanning two or more generations) on people and areas? How does time spent in poverty and in poverty areas relate to motivation, aspirations, ambitions, and involvement in economic and social affairs?

7. What is the relationship of institutional structure (finance, government, system of trade and exchange, labor, family, education, property, etc.,) to poverty conditions and individual characteristics of poverty? Are there institutional rigidities that hinder development?

8. What are some of the more dependable methods for identifying and anticipating poverty communities? What is their structure and how do they function and relate to the larger society? What are the channels of communication with the larger society and what is their relative efficiency under specific conditions?

9. How can agencies and organizations best combine forces for a joint attack at the local level on the poverty problem? What degree of centralization in planning and executing programs is most desirable in attacking various kinds of local needs and problems? Are the programs and services too standardized?

10. What are the most meaningful types of organizational effort needed for the development of transportation, roads, schools, health facilities, and services?

11. What are the most appropriate forms of investment in "human capital", and what are the expected returns in relationship to investment in material goods?

12. How are various kinds of community decisions made with respect to obtaining and providing needed programs, services and facilities? How do group processes among people vary at different stages of community and program development? What are the types and characteristics of leaders most responsive to the needs and which at the same time have the respect and the confidence of the people?

13. What is the proper balance of public and private programing, provision of services, and spending in relationship to the needs, capacities, and

values of different socioeconomic category groups of persons and families?

14. What are the characteristics and the potentialities of an "optimum" community? What are the gaps between the communities as they exist in any given area and the "optimum" community?

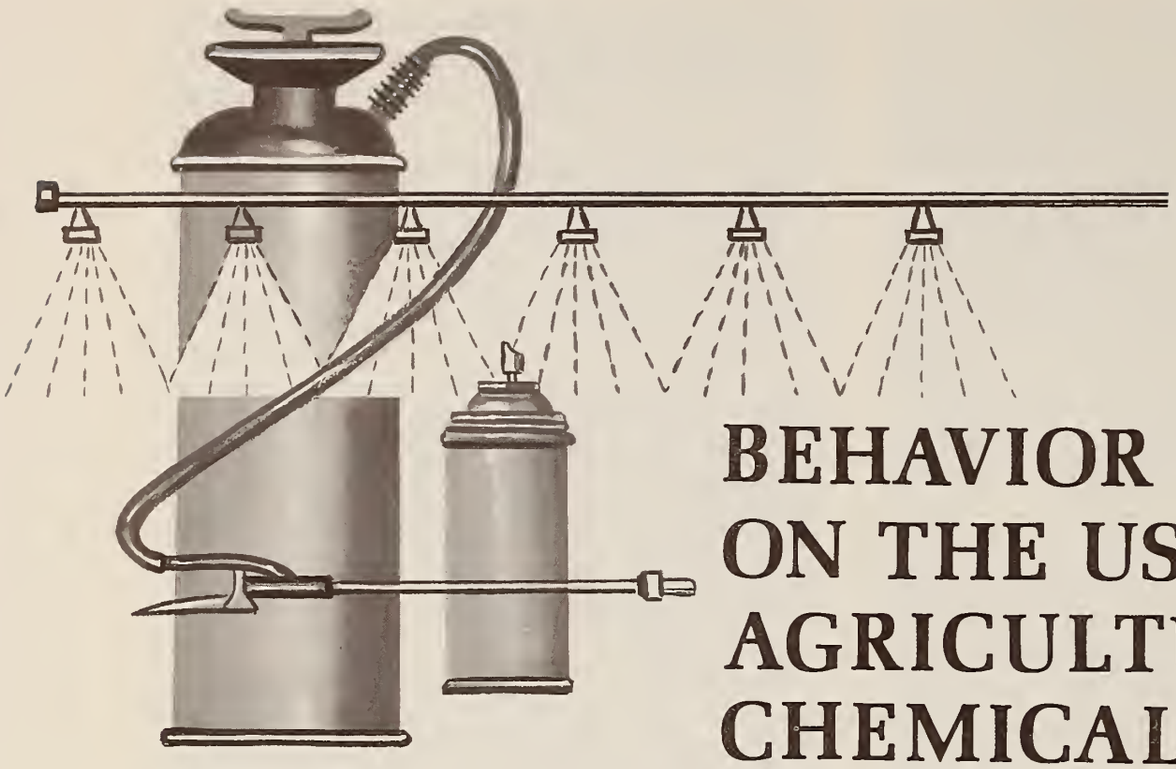
15. In relationship to the "optimum" community, what is the investment required for the development of the human resource factor to the "optimum" level? And, how will this vary from area to area and region to region? How far will this investment go toward overcoming the loss in gross national product resulting from inadequacies in the human resource factor?

16. In any consideration of the encouragement and development of the concept of growth centers, what is the probable impact in terms of bringing about social change and effecting community and human resource development? What will be the social cost in bypassing population groups who are beyond the reach or influence of the growth centers? What are the available criteria for evaluating the long-time results of growth center development? Will the growth centers and their surrounding areas be meaningful for organizing various kinds of programs and activities and as places and areas with which people identify?

Although the foregoing list might seem unduly long, it is correctly indicative of the paucity of knowledge concerning emerging social problems generated by the increasing rapidity of social change. All of these questions are well suited for study at both national and State levels. At the State level, the land-grant universities—because of their station research experience, the availability of data and additional expertise in the colleges of arts and sciences and through ready-made contacts with local people—are in an excellent position to strengthen research programs dealing with community and human resource development problems at the local, State, and regional level.

Despite the fact that behavioral science is historically later and numerically smaller than other sciences, our research efforts to date have paid off remarkably well. This payoff cannot always be measured in dollars and cents or even in numbers of people benefited. Most of it falls in the category of improved understanding of behavioral phenomena. Indirectly, of course, this research has benefited society through the reduction of social costs that might otherwise have occurred as the result of inadequate knowledge and poor judgment in developing programs.

But the research opportunities facing behavioral scientists—particularly rural sociologist—are even more challenging than any to which they have applied their talents in the past. To meet these challenges will demand an even sturdier emphasis on the "why" answers as an increasing complement to the "how's" and "what's." The forces at work in the world today are creating social imbalances that have produced a whole new complex of economic and noneconomic variables and interrelationships. Our populations are becoming increasingly literate, exacting, demanding, vocal, and mobile. Thus, the behavioral scientist who asks "why" must learn to understand the motivations and aspirations of people. Above all, he must learn how their institutions and organizations can be developed to enhance and help fulfill these aspirations.



BEHAVIOR STUDIES ON THE USE OF AGRICULTURAL CHEMICALS

A REPORT published by Iowa State University [1] presents some very interesting and significant data about the use patterns, knowledge, and attitudes of Iowa farmers concerning agricultural chemicals. Obviously, the report will be most useful to those whose jobs deal with providing information to farmers on how to use agricultural chemicals safely and effectively. But, as the authors point out, the report should also be helpful to an even wider group—including those who establish and enforce public policies and those who conduct educational programs related to proper use of agricultural chemicals.

Because many of our readers are in the latter groups, the staff of *Review* believes that a published condensation of the report will broaden its utility. Furthermore, the subject matter in this report is closely related to an area of science activity and research management where coordination and teamwork are prime requisites. Thus, the condensation fulfills one of the basic functions of this journal. Particularly in the field of agricultural chemicals, public understanding of new technologies developed by agricultural science should be a matter of concern to the administrator and the bench scientist alike, as well as to teachers and Extension personnel.

Those who read the full Iowa report may be somewhat surprised to learn that not all farmers know that:

1. Chemical containers should not be reused.
2. Empty aerosol cans should not be put in the trash and burned.
3. Milk from a cow treated with antibiotics for mastitis may not be sold until 96 hours after treatment.
4. The Food and Drug Administration—not the Department of Agriculture—has the major responsibility of enforcing proper use of insecticides.

Even though such misinformation can be attributed to only a minority of the farmers in the survey, the situation carries some significance when one realizes that 96 percent of the farmers used one or more of the seven categories of agricultural chemicals.

It should be emphasized that the research in the Iowa report touched only part of a large and complicated subject. Farmers are only one of several groups of users of the many, widely varying kinds of agricultural chemicals. Moreover, the research applied to only a random sample of 229 Iowa farmers, and therefore the findings may be more useful

[1] *Behavior Studies Related to Pesticides, Agricultural Chemicals, and Iowa Farmers.* George M. Beal, Joe M. Bohlen, and Herbert G. Lingren. Sp. Rept. No. 49, Iowa State University of Science and Technology, Ames, December 1966.

to those interested in knowledge, attitudes and use patterns of Iowa farmers. The data may, however, provide useful concepts and insights that would apply in a broad fashion to behavioral studies on the use of agricultural chemicals.

One basic assumption of the Iowa study was that there is a need to understand, predict, and—in some cases—modify human behavior related to the use of agricultural chemicals. Four variables were emphasized: farmer use and expenditure patterns, knowledge, attitudes, and sources of information concerning these chemicals.

Use and Expenditure Patterns

ONE of the first steps toward understanding the behavior of farmers as related to agricultural chemicals is to analyze use and expenditure patterns. The existing behavior, as determined by the data, will provide a context in which to interpret the other variables—knowledge, attitudes, and sources of information.

As already stated, the study revealed a widespread use of seven categories of agricultural chemicals among the farmers sampled. Livestock insecticides were the most-used chemicals, followed closely by broadleaf weed killers, animal health products, and soil insecticides. The other three categories—brush killers, grass killers, and crop insecticides—were little used compared to the other four.

The average expenditures for all farmers was $168—33 percent of which was for animal health products, 30 percent for herbicides, and 37 percent for insecticides.

Farmer Knowledge

THE range in the percentages of correct, incorrect and don't-know or no-opinion answers varied widely. Ninety percent of the farmers answered correctly 4 out of 5 items directly concerned with safety. But nearly 70 percent stated that the U.S. Department of Agriculture had the responsibility to enforce the proper use of insecticides when, actually, the major enforcement responsibility rests with the Food and Drug Administration.

They also believed that when pests become resistant to present chemicals, new chemicals have to be made more poisonous to kill them. This leaves out the alternative of developing a new chemical that will kill the pest, but actually be less or no more poisonous.

Nearly half the respondents answered incorrectly a question dealing with the recommended dosage of 2,4-D on corn—by far the most used weed killer.

The highest percentage of don't-know or no-opinion answers resulted from questions about specific uses of specific herbicides and insecticides.

Several knowledge questions dealt with restrictions placed on the use of crops or produce after being treated with agricultural chemicals. A wide range of correct answers appeared here also. For example, 76 percent answered correctly a question dealing with the withdrawal of stilbestrol before marketing. However, for a question on the use of amino triazole on thistles and the recommended time period before livestock should be allowed on the pasture, only 30 percent gave correct answers.

Farmer Attitudes

IT is difficult and possibly misleading to combine the responses to individual attitude statements into statements that may be generalized to apply to the majority of farmers.

However, if one assumes that (*a*) individual attitudes can be aggregated and combined, (*b*) attitudes within individuals are consistent, and (*c*) if positive statements had been given as negative statements instead, the same conclusion about attitudes would be drawn—then the following summary statements appear warranted:

A majority of the farmers appear to have these favorable attitudes toward the role of agricultural chemicals:

1. The proper use of agricultural chemicals is the best way to get rid of nuisance plants and to control pests. Through their use man has managed to stave off disease and starvation in many parts of the world.
2. Agricultural chemicals are one of the primary factors contributing to the U.S. standard of living and way of life. They are an essential tool if the American farmer is to continue to produce good food at reasonable prices. Food and meat produced before the introduction of agricultural chemicals did not have less foreign contaminants and was not of higher quality.
3. The use of agricultural chemicals is a profitable input in the farmer's operation.

When considering the possible danger of agricultural chemicals to humans, a majority of the farmers agreed that:

1. Agricultural chemicals, if properly used, will not be harmful to humans.
2. Almost all deadly effects of agricultural chemicals are due to improper handling, a disregard for safety precautions, or improper use.
3. While few, if any, foods are entirely free of chemical residues, these residues are well below the minimum health tolerances.
4. Agricultural chemicals are not "dangerous and little recognized partners of radioactive fallout in changing the very nature of the world and life itself." The continued or increased use of agricultural chemicals will not produce cancer and leukemia in humans.

In terms of responsibility for testing, marketing, education, and use related to agricultural chemicals the following generalizations appear to apply to the attitudes of a majority of farmers.

1. Agricultural chemical companies are not producing and selling chemicals before they have adequate information regarding hazards of handling and possible consequences of use. They are not negligent in warning the public of potential hazards of their products.
2. University research specialists do not report favorable results simply because they receive research grants and salary from chemical companies.
3. Most dealers or suppliers who sell agricultural chemicals to the farmer do have adequate information about proper application, hazards of handling and possible consequences of misuse.
4. The user of agricultural chemicals must assume responsibility for any consequent harmful effects to plant, animal, or human life.

A point on which three-fourths of the sample farmers agreed is that government agencies should spend more time and energy trying to determine the immediate and long-range consequences of chemical use.

Considering the possible negative consequences of agricultural chemicals to wildlife, the attitude pattern is not clear. The following attitudes, not necessarily inconsistent with each other, are held by the majority of farmers:

1. The present use of agricultural chemicals is polluting our rivers and destroying wildlife.
2. Agricultural chemicals are not the main cause of water pollution that kills fish. And continued spraying will not exterminate the robins.

There is a high measure of agreement that use of agricultural chemicals is the best way to get rid of pests. Still, the majority believe that good cultural practices are more effective than chemicals in controlling weeds. On the other hand, most farmers believe that introducing natural enemies of the insects is not an effective control of these pests.

There were also a number of attitude statements where there was little agreement. The agree and disagree response distribution was within the range of 40 to 60 percent. Among these response areas were the following attitude statements:

1. The use of agricultural chemicals upsets the balance of nature.
2. There is great danger from eating food treated with agricultural chemicals because of the buildup of chemical residues in the human body.
3. Insecticides used at recommended rates build up in the soil to kill life other than the insects they are supposed to kill.
4. There has been a steady decline in all wildlife numbers since the use of agricultural chemicals began. And, more specifically, roadside weed spraying kills great numbers of wildlife.
5. Agricultural chemicals should be labeled "poison" and sold only by persons licensed to do so.

Information Sources

IN order to know how to reach farmers with chemical information, the respondents were asked what information sources they use to learn about agricultural chemicals. Each respondent was given a list of types of information sources. This list included companies and dealers, USDA-Extension, community organizations, mass media, personal sources, and product containers. The validity of the

various types of information sources listed was based on past agricultural chemical research with farmers and field testing prior to the actual survey.

The most frequently named source of information was farm magazines and papers—named by 94 percent. Ninety percent of the farmers indicated they obtained information from the product container. Other frequently named sources of information were: other farmers in the community, 68 percent; local agricultural chemical dealers, 61 percent; radio, 49 percent; county extension personnel, 48 percent; veterinarians, 44 percent; and agricultural chemical company publications, 42 percent.

The local agricultural chemical dealer and farm magazines and papers were regarded as the most useful sources in helping select the best chemical to do the job—each named by approximately one-fifth of the sample.

Almost 70 percent stated that the product container was the most useful source for methods and rates of application; 62 percent said it was the most useful for safety precautions. The container was also named as a useful source regarding hazards and possible harmful consequences as a result of misuse. Slightly over half the farmers questioned named farm magazines and papers as the most useful source of information about new chemicals.

A Final Note

AT the beginning of their report, the authors stated that little valid data had been available on which to base discussion and interpretation of the controversial subject of agricultural chemicals. Now, at least part of this information for Iowa is available. More will be presented in later reports.

Need for these data has been expressed for some time. As chemicals become more and more important to agriculture, adapting this information to practical use should result in the best use of agricultural chemicals for top agricultural products.

In keeping with USDA policy, research workers are urged to exercise constant vigilance in the use of herbicides to assure the protection of human health by avoiding unnecessary exposure of crops, livestock, fish, wildlife, and water supplies.

CURRENT RESEARCH INFORMATION SYSTEM

USDA's Newest Development in Information Retrieval

JAMES TURNBULL

BY the mid-1940's, the complexities of communicating and coordinating problems were already beginning to be a matter of concern to most science disciplines. The sheer abundance of recorded knowledge and the growth rate thereof seemed to foreshadow a crisis of inundation. The science community was rapidly losing its ability to adequately and efficiently store, analyze, and distribute new knowledge to the points of need. In short, scientists were in trouble—simply because their long-accustomed habits of sharing knowledge were becoming hopelessly outmoded.

In some respects, the agricultural disciplines did not begin to feel the effects of the new crisis quite as rapidly as other disciplines did. A sense of autonomy within each specialized field fostered an adequate network for exchanging information among research workers. Actually, it was possible for a researcher to know most or even all of the people in the U.S. Department of Agriculture and in the State experiment stations who were working on a specific range of problems. (To a certain extent, this is still true today.) But as specialization increased and as the interdisciplinary approach became more and more pronounced, researchers discovered that their established channels of information exchange could not provide them with all the peripheral knowledge they needed to know.

Compounding the problem of keeping fully aware of new and related work is the delay which is frequently encountered in publishing research results. Some professional journals require 6 months to 2 years to publish papers submitted to them. Add to this the 2 to 5 years normally required from initiation of a research project to preparing the report, and the magnitude of the gap in the flow of information is quite evident. At present it must be filled largely by personal contact and correspondence. As research programs have proliferated and the tempo of our needs has increased, there has been mounting concern about ways of improving the transfer of information about on-going research.

A number of years ago, an attempt was made to solve the problem of keeping everyone informed as to what research is being done, where it is being done, and by whom. Each experiment station director and each major field station of the Department was furnished with a complete set of card abstracts covering the research underway throughout the country. These sets include an abstract of every research project being conducted either by the State stations or by USDA.

This system, however, has had only limited success. The sets were cumbersome, difficult to use and maintain, not always fully informative, and not as readily available as they should have been. They contained no information on funds or manpower allocations. This lack of management-type information was a particularly serious shortcoming.

Need for a Better System

AS the Department began to feel the pressure of increasing demands from Congress, from industry, and from within Government for better and more complete information on the combined State-USDA research program, administrators realized that a

more effective system needed to be established. The first step was the establishment of a project system task force in July 1964 by Dr. Nyle C. Brady—then Director of Science and Education. This group recommended that research coordination and communications in USDA could benefit by introducing electronic data processing. Preparations for the introduction of automation called for unification of policies and processes of the research programs of the Department and the States (where possible) into a single overall systems framework with integrated procedures for long-range planning, annual planning, and research reporting. The present effort to develop an effective information system is really the culmination of the efforts of the 1964 task force.

The long-range study [1] has since provided a more specific look at the various categories of research. It, together with its related inventory of research, was designed, however, as a one-time approach. Day-to-day management requires a continual updating of the inventory. In addition, administrators are frequently faced with the problem of identifying costs and manpower allocated to research on subjects that are really subdivisions of the long-range study categories, and which are not identified in the study itself.

Establishment of CRIS

THE Current Research Information System—now widely known as CRIS—was officially established in April, 1966. CRIS is an automated information storage and retrieval system designed to do two things:

1. Improve communications among scientists with regard to research which is presently underway.
2. Provide more effective management information on the total research programs of the State stations and the U.S. Department of Agriculture.

CRIS has been planned in three phases. Phase I, which is now complete, was a survey of needs and a preliminary systems design study. Phase II, the contract for which has just been awarded, is the implementation of the system. It is scheduled for completion in 12 months. It will include the development of forms, development of machine programs and software, collection and insertion of project data into the system, and testing and debugging of the systems operation. Phase III, also scheduled for 12 months, originally called for contract operation of the system, including training of USDA personnel in operating procedures and eventual direct operation by USDA. We are presently reviewing the need for phase III, and USDA staff may take over full operation at the end of phase II.

Scope of CRIS

THE system, as it is currently being implemented, provides for management and scientific information to be stored on magnetic tape. An inquiries subsystem involving an inverted file of project identifications on random access disk storage will permit direct referral to the projects containing the desired information.

Management information will include: (1) the amount of money allocated to each project from each source of funds, (2) manpower allocations by types of manpower—scientists, professional support, and subprofessional support, and (3) the title of the project, the name of the project leader, and the institution or USDA agency conducting the work and the identity of any cooperators.

Scientific information will include a brief description of the project objectives, plan of work, progress, and a list of publications resulting from the research.

The inquiries subsystem will contain keywords which describe each project—as many as 10 or even 15 keywords per project. It will also contain classification data for each project which will permit identification by activity, by commodity or resource, or by field of science. These classifications are the same as those used in the long-range study and provided by the stations on CSRS Form 141 and by the USDA agencies on Form T–2.

This scope of information gathering will not be as overwhelming a chore as one might suppose. Information presently being provided by State stations through the project outline and Form 20, the annual program submission, the annual financial report, and the annual progress report will provide nearly all the basic information needed for the system. Changes in timing or format and some con-

[1] "A National Program of Research for Agriculture," report of a study sponsored by the National Association of State Universities and Land-Grant Colleges and the U.S. Department of Agriculture, October 1964.

solidation of present reporting procedures will probably be required, but we do not expect material changes in present fiscal or scientific record keeping procedures at the State stations. The individual experiment station project will continue to be the principal reporting unit for the State stations; and will be the basic financial, management, and scientific information building block of the State portion of the system.

Similarly, in the USDA agencies, it is expected that most existing line projects will convert readily into the work units which are the basis of the USDA segment of the system. The principal difference between the present line project and the new work unit is that the work unit will reflect work on a specific identifiable problem at a single location. Line projects, in many instances, have covered research at several locations.

CRIS is being designed to utilize as much as possible of existing report procedures and to adapt them to the latest developments in automatic data processing equipment, to provide better analysis and dissemination of information. The Department is working hard to simplify existing procedures and to prevent CRIS from merely adding one more layer to an already onerous reporting system.

Present plans are to design, implement and operate the CRIS program with funds already available. The Cooperative State Research Service, together with other research agencies of the Department, will contribute to these costs. No charges are expected to be made for routine use of the system. Charges may be necessary, however, for special, complex, and expensive searches and analysis.

Mode of Operation

THE Current Research Information System will serve two groups—research scientists and research administrators.

A scientist, wishing to know about related work in his own field of interest, will be able to query CRIS and receive a listing of specific projects that fit his inquiry. The listing will include who is doing the work, where it is being done, the nature of the work, statements of progress, and citations to publications resulting from the research. Inquiries will need to be carefully prepared to identify the specific area of interest.

Obviously, such a brief summary will not provide all the scientific information a researcher might want. It will, however, give him a lead as to the particular individuals with whom he should correspond if he finds some particularly intriguing research about which he desires more information.

From the management standpoint, administrators in Washington on many occasions have needed information on research programs and simply have not had it readily available or not available in the proper form. Mostly their requests have been for reasonably accurate estimates of dollars or man-years being spent on particular lines of research at particular locations or on specific commodities. Many times we have telephoned or written several or all stations to obtain the needed information.

The ability of CRIS to aggregate information in a wide variety of ways should provide the answers needed to meet recurrent report requirements and many special report requirements. We believe that this capacity will be most helpful in reducing the burden of requests for special information from the State stations.

An agricultural research information system must be closely associated with other research information systems and with the published literature. It is important, therefore, that CRIS be viewed in the context of the total information storage and retrieval problem which faces the entire research and development community. CRIS is the USDA–SAES approach to meeting management and scientific information needs in the agricultural research sector. It must be compatible with other efforts in Government to identify and aggregate total research programs.

With the wide diffusion of effort among federal agencies, there is at present no satisfactory way of obtaining a picture of the total Research and Development program or of effectively coordinating it.

A first step in developing a Government-wide information system has recently been taken by the Federal Council for Science and Technology. A task force of the Federal Council has recommended the establishment of a national information storage and retrieval system to cover all federally-supported research. Various agencies of the Federal Government are now exploring ways to determine the feasibility of such a system. In the development of CRIS we have been very much aware of this possible national system, and are doing all possible to make

certain that we will be compatible with such a system.

Coordination of Effort

THROUGHOUT the development of CRIS, the Department has worked closely with the Science Information Exchange (SIE). At present SIE is the nearest thing the United States has to a Government-wide research information exchange. Presumably it will have a role in any national system which may develop. SIE has some 100,000 projects in its files. These come mostly from Government research agencies, about 125 research foundations, and many State agencies. All of the USDA and State agricultural experiment station research on which we have received Form 20's is included in the SIE system. The U.S. Department of Agriculture will continue to work closely with SIE in exchanging information. We will provide SIE with information on the research supported by the Department and the State stations, and we will receive from SIE information on related work being supported by other agencies and foundations. In general, SIE does not obtain as much information on each project as will CRIS. Therefore, the information available from SIE on related research is likely to be less complete than that available in the CRIS system.

The Committee on Scientific and Technical Information (COSATI) also is concerned with improving the flow of information in the scientific and technical area and has task forces working on:

1. Developing compatible reporting systems.
2. Techniques and systems for information storage and retrieval.
3. Management of information activities.
4. Formats for presenting information.
5. International information exchange.
6. Other aspects of improved communication.

At the executive department level, the Department of Defense and the National Aeronautics and Space Agency have agreed on similar report forms containing 26 common data elements for reporting on-going research. Common data elements are entered into computerized information systems and can be freely transferred between these two agencies as they keep each other informed about their research activities.

The Defense Documentation Center and the Clearinghouse for Federal Scientific and Technical Information of the Department of Commerce, both of which have been organized within the past few years, provide copies of published scientific material.

A more specialized information system in the medical area is MEDLARS—the Medical Literature Analysis and Retrieval System which is a part of the National Institutes of Health.

And finally, the National Agricultural Library has awarded a contract for the development of an improved and automated system for retrieval of published information. CRIS will be fully compatible with the National Agricultural Library. We plan, for example, to use the vocabulary which is being developed by NAL and are working with it to include terms we will need. In addition, we plan to use uniform search techniques and we fully anticipate sharing the same data processing equipment. We envisage a request coming in from a scientist which will be answered by a printout of relevant research projects from CRIS and relevant publications provided by a joint search routine of CRIS and the National Agricultural Library.

This many-pronged effort [2] to improve information flow and retrieval in the research and development area is an indication of the seriousness with which the problem is viewed. In CRIS we are trying to profit from the experiences of the existing programs and are designing our system to meet as many needs as we can foresee.

The Department of Agriculture is hopeful too that, as the State stations develop information retrieval systems for their own internal use, direct tape transfer of data can be arranged between CRIS and the State systems so that we can effectively complement each other. Presumably, when CRIS is operational, scientists will find many uses for the information that the system will be able to provide. The improved availability of information to both scientist and administrator—at all levels—should more than repay the investment in time and effort required in providing the basic project information for the CRIS program.

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[2] See also: "Communicating and Coordinating Agricultural Research: A Review of Federal Facilities," *Agricultural Science Review*, vol. 3, No. 3, 1965, pp. 1–17.

A quarterly review of the international biological program

Project Telma

AN international technical meeting on the conservation of peatlands in northern regions, held at Shrewsbury, England and Bangor, Wales in June 1967, marked the initiation of Project Telma as a segment of IBP's subject-matter section, Conservation of Terrestrial Communities.

Sponsored by IBP, UNESCO, and the International Union for Conservation of Nature and Natural Resources, the meeting recognized that peatlands are a vital component of the biosphere and noted that:

> Peatlands are being utilized for an increasing range of purposes.
>
> Peat extraction and reclamation of peatlands for agriculture and forestry are accelerating rapidly in some regions and are anticipated in others.
>
> Large-scale drainage and other hydroengineering projects are an increasing threat to the hydrological regime within peatlands.
>
> Increased mineral cycling is affecting the biotic systems of peatlands, because of modern fertilizing methods, eutrophication of ground water, and deposits of pollutants from the atmosphere.

In view of these threats to the continued existence of world peatland types, the meeting resolved that a review of the pattern and rate of progress of peatland utilization should be undertaken forthwith, and recommended that a world plan for the conservation of peatland types should be prepared and recommendations made to governments for its adoption.

Project Telma will be concerned with any part of the earth that is covered with peat and the flora and fauna it supports—that is, peatforming ecosystems and ecosystems that have developed on peat deposits. Although Project Telma will be concerned with the entire world, initially it will cover those countries situated wholly or partly north of the northern subtropical arid zone.

The main objectives of Project Telma are: (*a*) preparation of a world list of peatland sites which are of international importance to science (Telma 1), and (*b*) encouragement of communication and collaboration among research scientists investigating peatlands, particularly in connection with productivity and bioenergetic studies (Telma 2).

The principal function of the meeting was to prepare for the implementation of Telma 1. Convener Dr. Tom Pritchard (Nature Conservancy, Bangor, Wales) was urged to organize immediately a crash program for the preparation of a preliminary handbook to include annotated lists and maps of peatlands of international significance.

Peatland types will first be classified on a national basis to obtain an indication of the range and extent of the types in each country. Then a short list will be prepared of sites of international significance as a basis for an international policy on peatland conservation.

The meeting recommended that the handbook should be readily understood by nonbiologists, and aimed at providing information for those concerned with policy and administration at government level. It was also recommended that the handbook explain clearly and simply why the conservation of peatlands—including some of those affected by human influences—is necessary, and that its recommendations are to be based on present scientific knowledge.

In order to prepare the handbook to the highest possible standard of accuracy, it was agreed that a questionnaire should be prepared and distributed for the use of specialists in all countries situated wholly or partly north of the northern subtropical arid zone, as a basis for providing information and assessment for the Convener and others responsible for compiling the handbook. An outline scheme—

prepared by Professor Hugo Sjors (Sweden) and Dr. D. J. Bellamy (United Kingdom) in consultation with Professor Radforth (Canada)—was agreed upon.

It was agreed that the 1968 Telma technical meeting should be primarily concerned with research on peatlands. It was noted, however, that the implications—from the conservation standpoint—of conducting large-scale productivity studies on peatland sites of scientific importance should be carefully considered. If such large-scale studies are undertaken, it will be essential to set aside areas for the work in addition to those that should be conserved for other purposes.

The meeting agreed that a firmly established organizational structure for Project Telma was essential, and the Convener was urged to seek the appointment of a national Telma representative in each country situated wholly or partly north of the northern subtropical arid zone.

The meeting expressed great concern about the current threat to the Florida Everglades—the only major area of this kind in existence. It stressed that this area is of the greatest importance to world science and that much of it should be allowed to remain in an undisturbed state.

Eutrophication Symposium

THE International Symposium on Eutrophication, held at the University of Wisconsin in June 1967, undoubtedly contributed to the world knowledge and understanding of the problem.

Symposium participants concluded it is now of greatest urgency to prevent further damage to water resources and to take corrective steps. Preventive and corrective measures suggested include removing nutrients from municipal, industrial, and agricultural wastes, controlling algae and aquatic plants with chemical and mechanical removal methods, and establishing shoreland corridor regulations to protect lakes from further damage.

The following recommendations to alleviate the worldwide problems caused by eutrophication were drafted at the symposium:

1. An effective, continuing information program should be implemented as soon as possible to inform the public about cultural eutrophication and the urgency for prevention and cure.

2. Major studies of eutrophication, and of possible steps to arrest and reverse the process, should be supported by Federal, State, local, and private agencies. Large-scale demonstration projects should be undertaken to determine the effectiveness of various approaches to the problem, and demonstration projects already in existence should be looked upon as models to evaluate their effectiveness. Additional research on a multidisciplinary basis should be undertaken to understand the mechanisms, processes, and consequences of eutrophication.

IBP in Israel

OF the many fine IBP projects being conducted in Israel, the one on energy metabolism of mammals exposed to heat is typical of the kinds of projects that bring benefits through international cooperation. This one is being conducted by the Department of Environmental Physiology, Negev Institute for Arid Zone Research, Beersheba, Israel. Dr. Y. Cassuto is in charge.

Previous studies have shown that mammals adapt to high ambient temperatures by decreasing production of body heat. For this process two mechanisms have been postulated: (1) decrease in total mass of heat-producing organs (liver, kidney, heart, etc.) and (2) decrease in activity of oxidative enzymes in some of these organs. Changes on heat exposure are essentially opposite to those recorded on cold exposure, indicating a cellular regulatory mechanism controlling production of energy and heat.

Recent investigations at the Negev Institute have demonstrated the dynamics of the development of adaptational changes with the duration of heat exposure. A new oligomycin-like control site of the mitochondrial respiration was found which begins to operate only after 2 weeks of heat exposure.

Related aspects of this research are being studied. A preliminary investigation has shown that the glycolytic system is also affected by heat exposure. Exact controlling sites will be investigated in the near future.

Eutrophication is the excessive fertilization of waters with nutrients, notably nitrogen and phosphorus, which ultimately result in the degredation of the material beauty and usefulness of the waters. The process is caused by natural as well as manmade causes.

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The biographical sketch of one of our authors—Dr. Leroy H. Wullstein—was inadvertently omitted from vol. 5 No. 2 of Agricultural Science Review. This biography follows:

LEROY H. WULLSTEIN ("Soil Nitrogen Volatilization") is assistant professor and environmental microbiologist, Department of Botany and Environmental Research Institute, respectively, University of Utah, Salt Lake City. He received his B.S. degree from the University of Utah (1957) and his M.S. (1961) and Ph. D. (1964) from Oregon State University. Prior to his present position, he was assistant professor of soil science (1964–66) at the University of British Columbia. He received a lecture-travel award from the National Research Council of Canada (1965) to present his research findings to laboratories and universities in the United Kingdom.

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